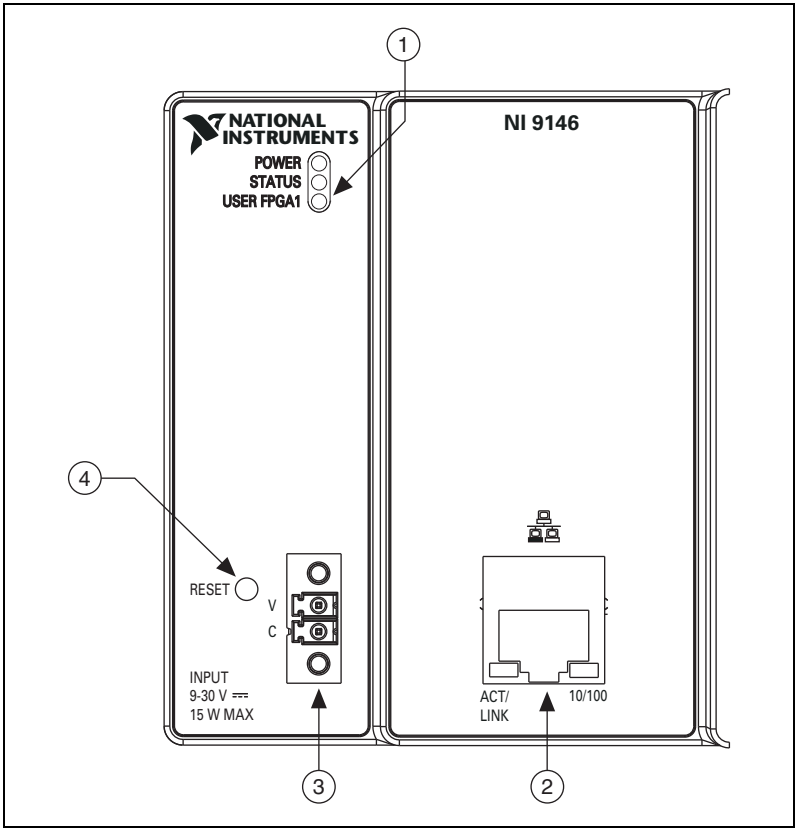
OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9146

Ethernet Expansion Chassis for C Series Modules



1	LEDs	3	Power Connector
2	RJ-45 Ethernet Port	4	Reset Button

Figure 1. NI 9146 Front Panel

This document describes how to connect the NI 9146 to a network and how to use the features of the NI 9146. This document also contains specifications for the NI 9146.

NATIONAL INSTRUMENTS

Safety Guidelines

Operate the NI 9146 only as described in these operating instructions.

Safety Guidelines for Hazardous Locations

The NI 9146 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class 1, Zone 2, AEx nC IIC T4 and Ex nL IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9146 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.

Caution Do *not* disconnect the power supply wires and connectors from the controller unless power has been switched off.

Caution Substitution of components may impair suitability for Class I, Division 2.

Caution For Zone 2 applications, install the CompactRIO system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.

Special Conditions for Hazardous Locations Use in Europe

Some chassis have been evaluated as Ex nA nL IIC T4 equipment under DEMKO Certificate No. 07 ATEX 0626664X. Each such chassis is marked ⟨Ex⟩ II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of $-40 \leq Ta \leq 70$ °C.

Special Conditions for Marine Applications

Some chassis are Lloyd's Register (LR) Type Approved for marine applications. To verify Lloyd's Register certification, visit `ni.com/certification` and search for the LR certificate, or look for the Lloyd's Register mark on the chassis.

What You Need to Install the NI 9146 Ethernet Expansion Chassis

- ❑ NI 9146 Ethernet expansion chassis
- ❑ NI-RIO Software DVD
- ❑ C Series I/O modules

- ❑ DIN rail mount kit (for DIN rail mounting only)
- ❑ Panel mount kit (for panel mounting only)
- ❑ Two M4 or number 8 flathead screws (for mounting the chassis without one of the listed mounting kits)
- ❑ A number 2 Phillips screwdriver
- ❑ Power supply
- ❑ Ethernet cable

Notes Visit `ni.com/info` and enter the Info Code `rdsoftwareversion` to determine which software you need to use the NI 9146.

Mounting the Chassis

You can mount the chassis horizontally on a flat, vertical, metallic surface such as a panel or wall. The maximum allowable ambient temperature for operation in this configuration is 70 °C. Figure 2 shows the chassis mounted horizontally.

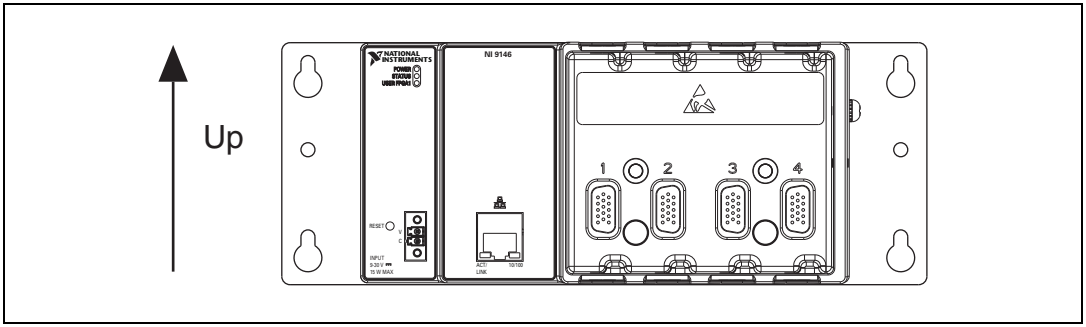


Figure 2. NI 9146 Mounted Horizontally

You can also mount the chassis on a panel or wall in other orientations, on a non-metallic surface, on a 35 mm DIN rail, on a rack, in an enclosure, or on a desktop. Mounting the chassis in these or other configurations can reduce the maximum allowable ambient temperature and can affect the typical accuracy of modules in the chassis.

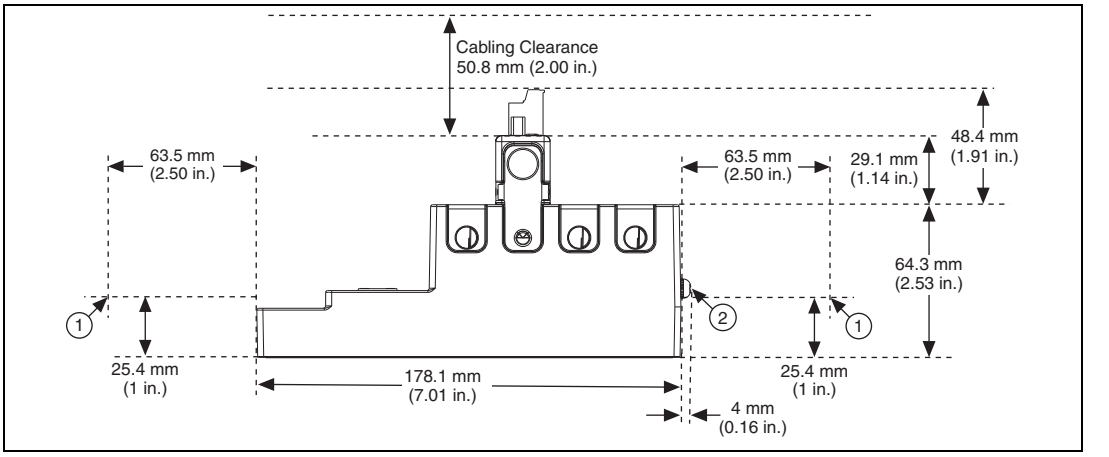
Note For information about how different mounting configurations can cause temperature derating, go to `ni.com/info` and enter the Info Code `criomounting`.

Note For information about typical accuracy specifications for modules, go to `ni.com/info` and enter the Info Code `criotypical`.

Note Measure the ambient temperature at each side of the chassis, 63.5 mm (2.5 in.) from the side and 25.4 mm (1 in.) forward from the rear of the chassis, as shown in Figure 3.

Caution Your installation must meet the following requirements for space and cabling clearance:

- Allow 25.4 mm (1 in.) on the top and the bottom of the chassis for air circulation.
- Allow 50.8 mm (2 in.) in front of modules for cabling clearance for common connectors, such as the 10-terminal, detachable screw terminal connector, as shown in Figure 3.



1	Measure ambient temperature here.	2	Chassis Grounding Screw

Figure 3. NI 9146, Bottom View with Dimensions

Note Go to `ni.com/info` and enter the Info Code `rdcrioconn` to find the minimum cabling clearance for C Series modules with other connector types.

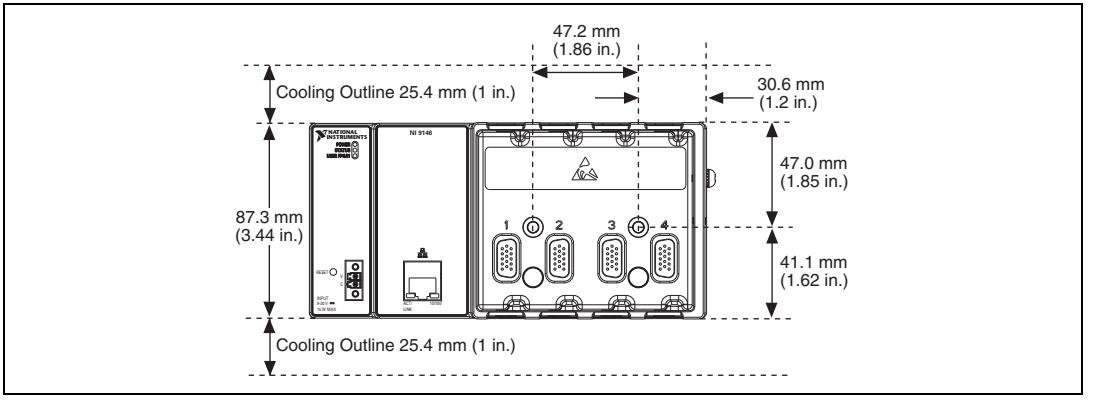


Figure 4. NI 9146, Front View with Dimensions

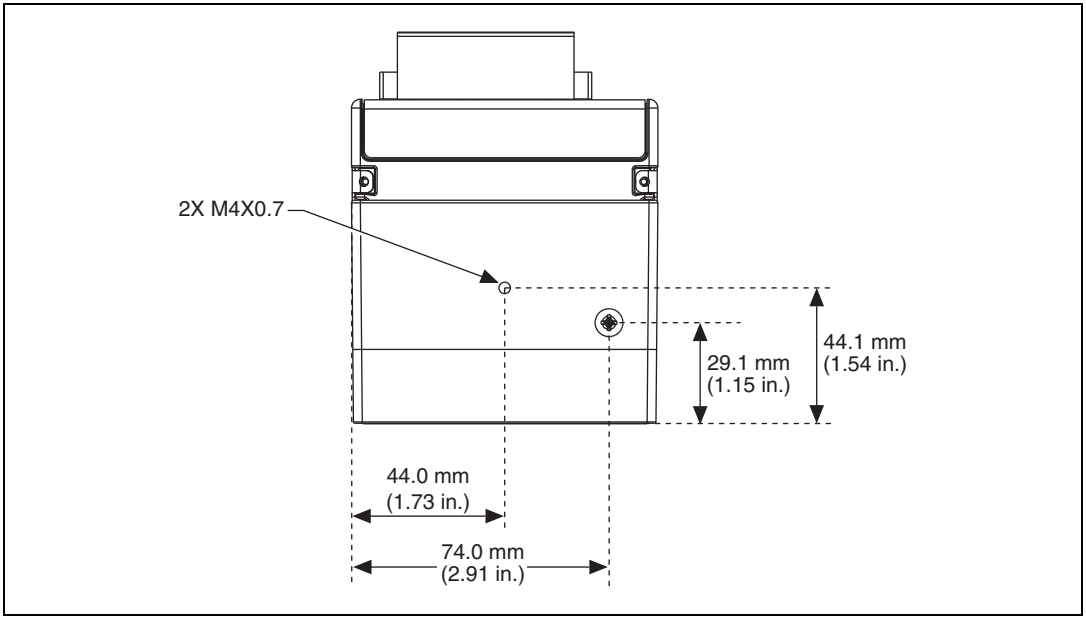


Figure 5. NI 9146, Side View with Dimensions

The following sections contain instructions for the mounting methods. Before using any of these mounting methods, record the serial number from the back of the chassis. You will be unable to read the serial number after you have mounted the chassis.

Caution Make sure that no I/O modules are in the chassis before mounting it.

Mounting the Chassis on a Flat Surface Using the NI 9904 Panel Mount Kit

Panel or wall mounting is the best method for applications that are subject to high shock and vibration. You can use the NI 9904 panel mount kit to mount the NI 9146 on a flat surface. Complete the following steps.

1. Fasten the chassis to the panel mount kit using a number 2 Phillips screwdriver and two M4 × 25 screws. National Instruments provides these screws with the panel mount kit. You *must* use these screws because they are the correct depth and thread for the panel. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

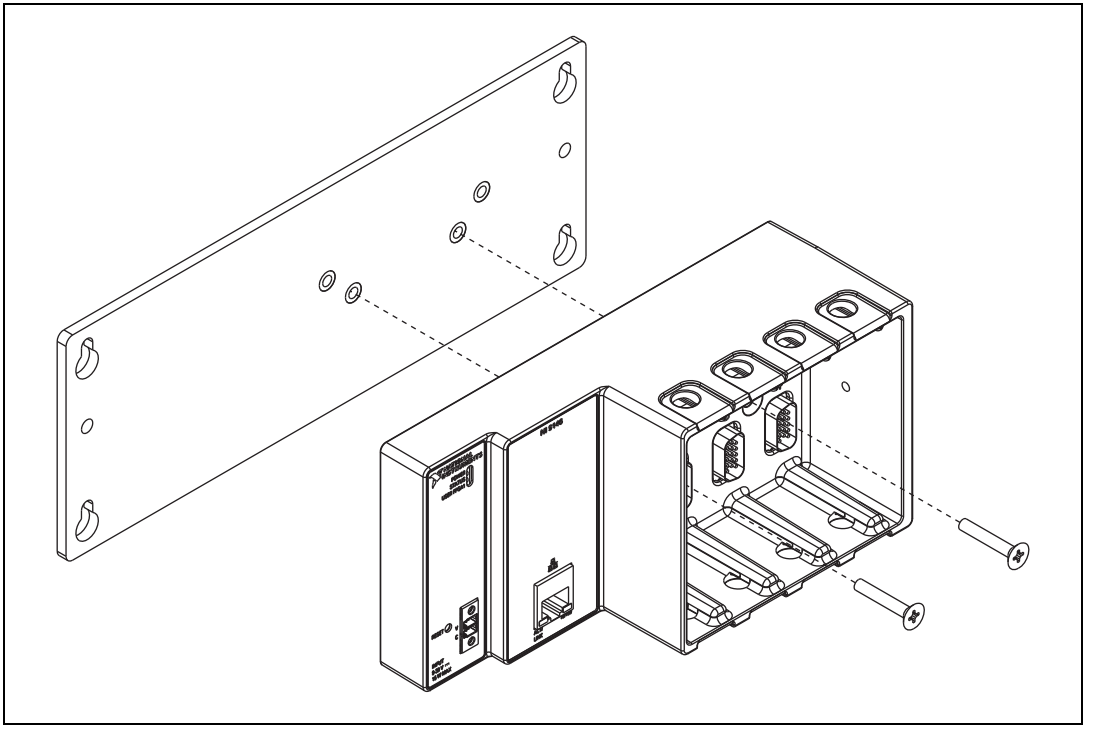


Figure 6. Installing the Panel Mount Accessory on the NI 9146

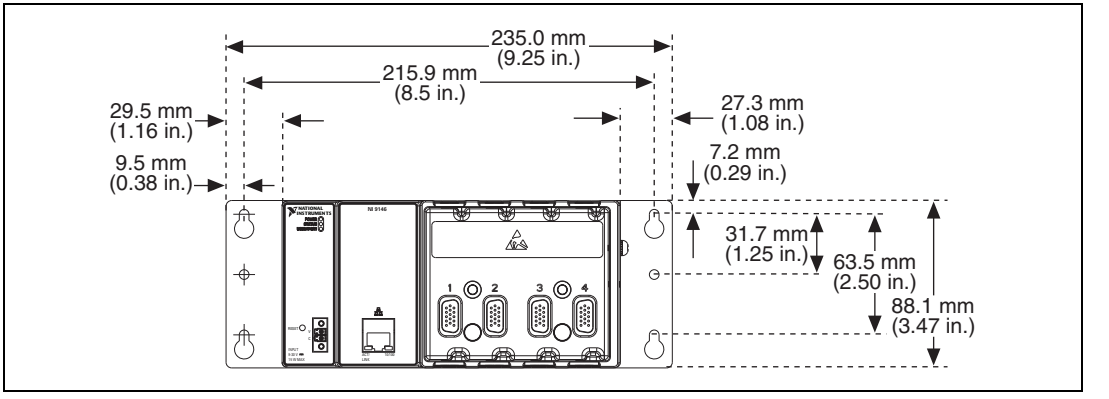


Figure 7. Dimensions of NI 9146 with Panel Mount Accessory Installed

2. Fasten the NI 9904 panel to the wall using the screwdriver and screws that are appropriate for the wall surface. The maximum screw size is M4 or number 8.

Caution Make sure that no I/O modules are in the chassis before removing it from the panel.

Mounting the Chassis Directly on a Flat Surface Using the Mounting Holes

Panel or wall mounting is the best method for applications that are subject to high shock and vibration. If you do not have the NI 9904 panel mount kit and do not require the portability that the NI 9904 affords, you can mount the chassis directly on a flat surface using the mounting holes. Complete the following steps.

1. Align the chassis on the surface.
2. Fasten the chassis to the surface using M4 or number 8 flathead screws, as shown in Figure 8. National Instruments does not provide these screws with the chassis.

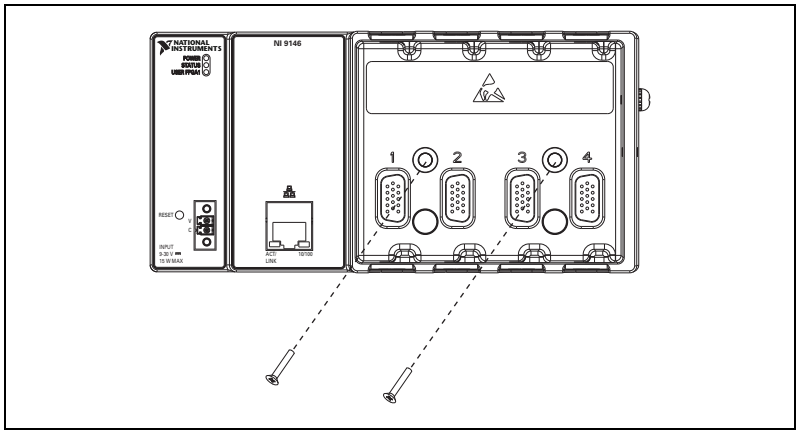


Figure 8. Mounting the Chassis Directly on a Flat Surface

Caution Make sure that no I/O modules are in the chassis before removing it from the surface.

Mounting the Chassis on a DIN Rail

You can order the NI 9912 DIN rail mount kit if you want to mount the chassis on a DIN rail. You need one clip for mounting the chassis on a standard 35 mm DIN rail. Complete the following steps to mount the chassis on a DIN rail.

1. Fasten the DIN rail clip to the chassis using a number 2 Phillips screwdriver and two M4 × 25 screws. National Instruments provides these screws with the DIN rail mount kit. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

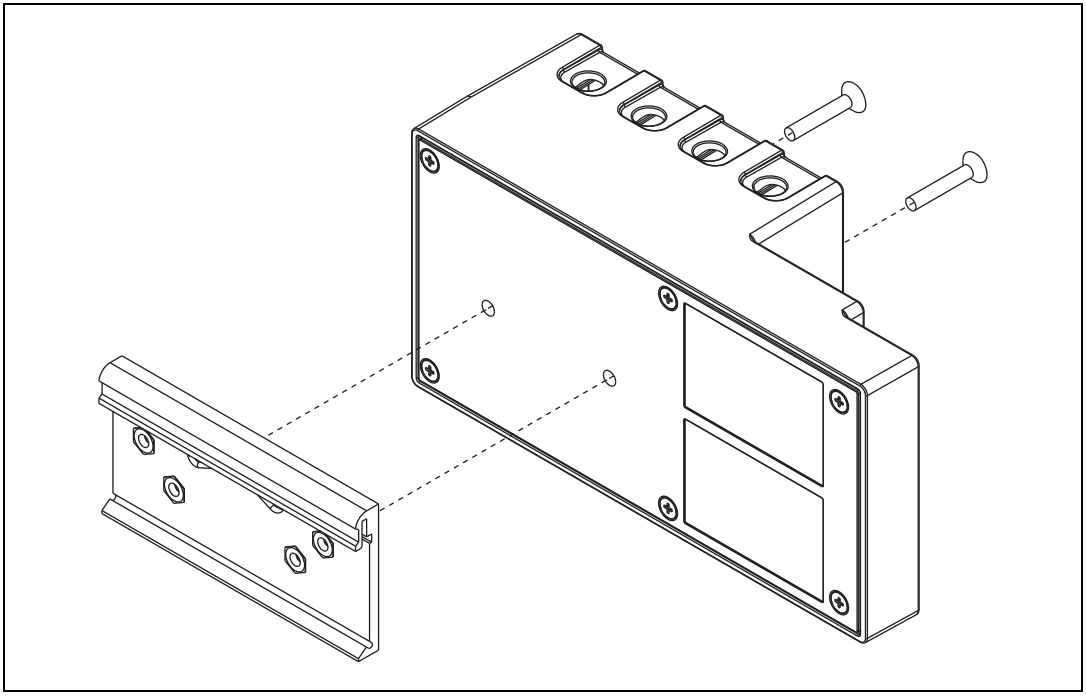
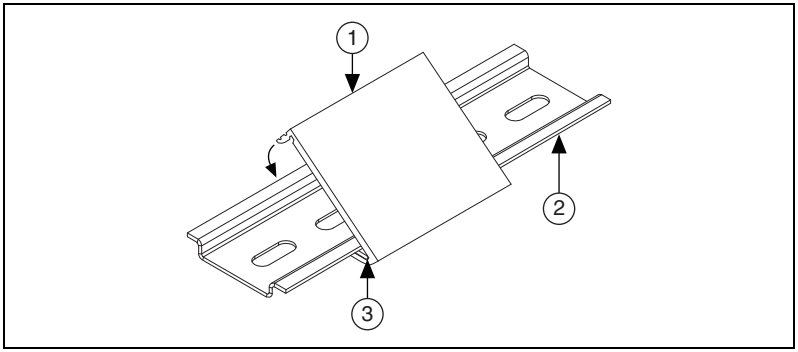


Figure 9. Installing the DIN Rail Clip on the NI 9146

2. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip, as shown in Figure 10.



1 DIN Rail Clip 2 DIN Rail 3 DIN Rail Spring

Figure 10. One Edge of the DIN Rail Inserted in a Clip

3. Press down firmly on the chassis to compress the spring until the clip locks in place on the DIN rail.

Caution Make sure that no I/O modules are in the chassis before removing it from the DIN rail.

Mounting the Chassis on a Desktop Using the NI 9901 Desktop Mounting Kit

You can use the NI 9901 desktop mounting kit to mount the chassis on a desktop. You must install the adapter bracket using two M3 × 20 screws. The adapter bracket and the screws are included in the kit. Refer to the NI 9901 documentation for information about mounting the chassis on a desktop.

Installing C Series I/O Modules in the Chassis

Figure 11 shows the mechanical dimensions of C Series I/O modules.

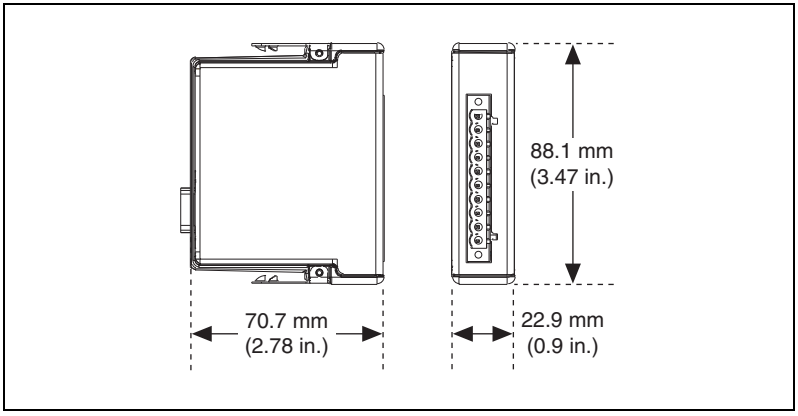
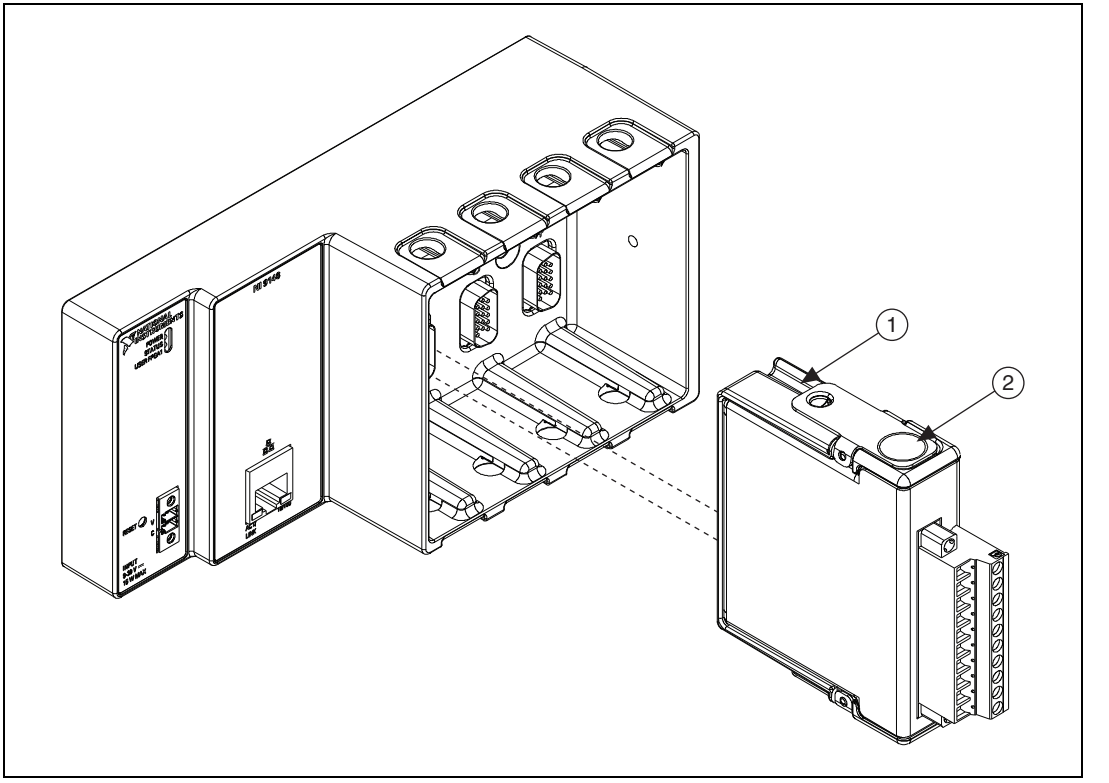


Figure 11. C Series I/O Module, Front and Side View with Dimensions

Complete the following steps to install a C Series I/O module in the chassis.

1. Make sure that no I/O-side power is connected to the I/O module. If the system is in a nonhazardous location, the chassis power can be on when you install I/O modules.
2. Align the I/O module with an I/O module slot in the chassis as shown in Figure 12. The module slots are labeled 1 to 4, left to right.



1 Insertion Groove	2 Latch

Figure 12. Installing an I/O Module in the Chassis

3. Squeeze the latches and insert the I/O module into the module slot.
4. Press firmly on the connector side of the I/O module until the latches lock the I/O module into place.
5. Repeat these steps to install additional I/O modules.

Removing I/O Modules from the Chassis

Complete the following steps to remove a C Series I/O module from the chassis.

1. Make sure that no I/O-side power is connected to the I/O module. If the system is in a nonhazardous location, the chassis power can be on when you remove I/O modules.
2. Squeeze the latches on both sides of the module and pull the module out of the chassis.

Connecting the Chassis to Earth Ground

You must connect the chassis grounding screw to earth ground. Refer to Figure 3 for the location of the grounding screw. Complete the following steps to connect to earth ground:

1. Attach a ring lug to a 1.6 mm^2 (14 AWG) or larger wire.
2. Remove the grounding screw from the grounding terminal on the right side of the chassis.
3. Attach the ring lug to the grounding terminal.
4. Tighten the grounding screw to 0.5 N · m (4.4 lb · in.) of torque.
5. Attach the other end of the wire to earth ground using a method appropriate for the application.

Note If you use shielded cabling to connect to a C Series I/O module with a plastic connector, you must attach the cable shield to the chassis grounding terminal using 1.3 mm^2 (16 AWG) or larger wire. Use shorter wire for better EMC performance.

For more information about earth ground connections, go to `ni.com/info` and enter the Info Code `earthground`.

Connecting the Chassis to a Network

Connect the chassis to an Ethernet network using Ethernet port 1 on the front panel. Use a standard Category 5 (CAT-5) or better shielded, twisted-pair Ethernet cable to connect the chassis to an Ethernet hub or a computer.

Caution To prevent data loss and to maintain the integrity of your Ethernet installation, do *not* use a cable longer than 100 m.

The first time you power up the chassis, it attempts to initiate a DHCP network connection. If the chassis is unable to initiate a DHCP connection, it connects to the network with a link-local IP address with the form `169.254.x.x`. After powerup, you must install software on the chassis and configure the network settings in Measurement & Automation Explorer (MAX).

Note Installing software may change the network behavior of the chassis. For information about network behavior by installed software version, go to `ni.com/info` and enter the Info Code `ipconfigcrio`.

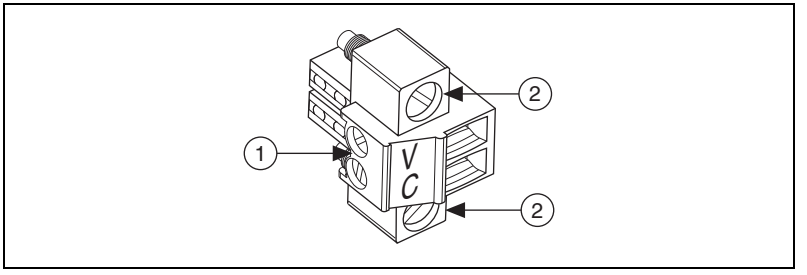
Wiring Power to the Chassis

The NI 9146 requires an external power supply that meets the specifications in the *Power Requirements* section. The NI 9146 filters and regulates the supplied power and provides power for all of the I/O modules. The NI 9146 has one layer of reverse-voltage protection. Complete the following steps to connect a power supply to the chassis.

1. Ensure that the power supply is turned off.

Caution Do *not* install or remove the power connector from the front panel of the NI 9146 while power is applied.

2. Connect the positive lead of the power supply to the V terminal of the COMBICON power connector shipped with the NI 9146, and tighten the terminal screw. Figure 13 shows the terminal screws, which secure the wires in the screw terminals, and the connector screws, which secure the power connector on the front panel.



1	Terminal Screws	2	Connector Screws

Figure 13. COMBICON Power Connector

3. Connect the negative lead of the power supply to the C terminal of the power connector and tighten the terminal screw.
4. Install the power connector on the front panel of the NI 9146 and tighten the connector screws.
5. Turn on the power supply.

Powering On the NI 9146

When you apply power to the NI 9146, the chassis runs a power-on self test (POST). During the POST, the Power and Status LEDs turn on. The Status LED turns off, indicating that the POST is complete. If the LEDs do not behave in this way when the system powers on, refer to the *Understanding LED Indications* section.

Restarting the NI 9146 Using the Reset Button

Pressing the Reset button restarts the NI 9146. The FPGA continues to run unless you have selected the **Autoload VI on device reboot** chassis reset option. Refer to the *Chassis Startup Options* section for more information.

To restart the NI 9146 in safe mode, hold the Reset button down for about 5 s, until the Status LED lights yellow, then release the button. The chassis reboots and the Status LED starts blinking three times every few seconds. The chassis is now in Safe Mode. Refer to the MAX help for information about safe mode.

Chassis Startup Options

Table 1 lists the startup options available for the NI 9146. These options determine how the chassis behaves when it starts up in various conditions. Use the RIO Device Setup utility to select startup options. Access the RIO Device Setup utility by selecting **Start»All Programs»National Instruments»NI-RIO»RIO Device Setup**.

Table 1. NI 9146 Reset Options

Startup Option	Behavior
Do Not Autoload VI	Does not load the FPGA bit stream from flash memory.
Autoload VI on device powerup	Loads the FPGA bit stream from flash memory to the FPGA when the chassis powers on.
Autoload VI on device reboot	Loads the FPGA bit stream from flash to the FPGA when you reboot the chassis either with or without cycling power.

Configuring IP Settings

When you power on the NI 9146 for the first time, it boots into safe mode because there is no software installed on it. This section describes how to configure the IP settings and install software on the chassis.

Complete the following steps.

1. Launch MAX on the host computer and expand **Remote Systems** in the MAX configuration tree. MAX lists the NI 9146 as the model name of the chassis followed by the serial number, for example, **NI9146-XXXXXXXX**.

   The chassis automatically attempts to connect to the network using DHCP. If DHCP is not available, the chassis connects to the network with a link-local IP address with the form `169.254.x.x`. You must connect the chassis directly to the host computer to configure it in this state.

2. Select the chassis under **Remote Systems** to see the **Network Settings** tab in the middle pane of MAX.
3. Enter a name for the chassis in the **Name** field.
4. Select settings for the chassis in the **IP Settings** section, then click **Apply**.

Note For information about configuring network settings, refer to the *Configuring Network Settings* book of the *MAX Remote Systems Help*. In MAX, click **Help»Help Topics»Remote Systems**. On the **Contents** tab, browse to **LabVIEW Real-Time Target Configuration»Configuring Network Settings**.

5. When you click **Apply**, you are prompted to reboot the chassis for the changes to take effect. Click **Yes**. You can also reboot the chassis by right-clicking the name under **Remote Systems** and selecting **Reboot**.
6. After rebooting, the chassis appears under **Remote Systems** with the assigned name. Expand the chassis and select **Software**.
7. Click **Add/Remove Software** in the toolbar to launch the LabVIEW Real-Time Software Wizard.
8. Install the Recommended Software Set that appears in the LabVIEW Real-Time Software Wizard.

For more information about configuring the chassis in MAX, refer to the *MAX Help*.

For information about installing and using LabVIEW FPGA, refer to the *LabVIEW FPGA User Manual*.

Understanding LED Indications

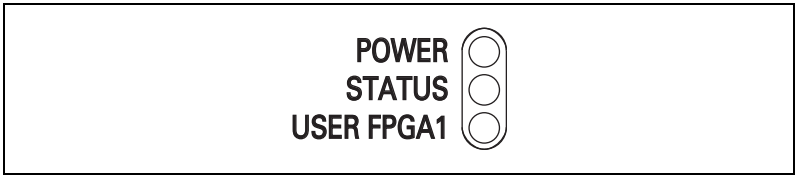


Figure 14. NI 9146 LEDs

POWER LED

The POWER LED is lit while the NI 9146 is powered on. This LED indicates that the power supply connected to the chassis is adequate.

STATUS LED

The STATUS LED is off during normal operation. The NI 9146 indicates specific error conditions by flashing the STATUS LED a certain number of times every few seconds, as shown in Table 2.

Table 2. Status LED Indications

Number of Flashes Every Few Seconds	Indication
2	The chassis has detected an error in its software. This usually occurs when an attempt to upgrade the software is interrupted. Reinstall software on the chassis. Refer to the *Measurement & Automation Explorer Help* for information about installing software on the chassis.
3	The chassis is in safe mode. Refer to the *Measurement & Automation Explorer Help* for information about safe mode.
4	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when the chassis runs out of memory. Review your RT VI and check the memory usage. Modify the VI as necessary to solve the memory usage issue.
Continuously flashing or solid	The chassis has detected an unrecoverable error. Contact National Instruments.

USER FPGA1 LED

You can use the USER FPGA LED to help debug your application or easily retrieve application status. Use the LabVIEW FPGA Module and NI-RIO software to define the USER FPGA1 LED to meet the needs of your application. Refer to *LabVIEW Help* for information about programming this LED.

Troubleshooting Network Communication

If the NI 9146 cannot communicate with the network, you can perform the following troubleshooting steps.

1. Hold the Reset button down for about 5 s, until the Status LED lights yellow, then release the button. The chassis reboots and the Status LED starts blinking three times every few seconds. The chassis is now in Safe Mode.
2. Repeat step 1. The Status LED repeats the same behavior. The chassis is now in Safe Mode with IP Reset.
3. Configure the IP and other network settings in MAX.
4. Press and release the Reset button to reboot the chassis.

Where to Go from Here

Now that you have set up the NI 9146 and configured it on your network, you can start using it in your applications. The following figure shows the main components of the CompactRIO documentation that you may find helpful as you program and use the NI 9146.

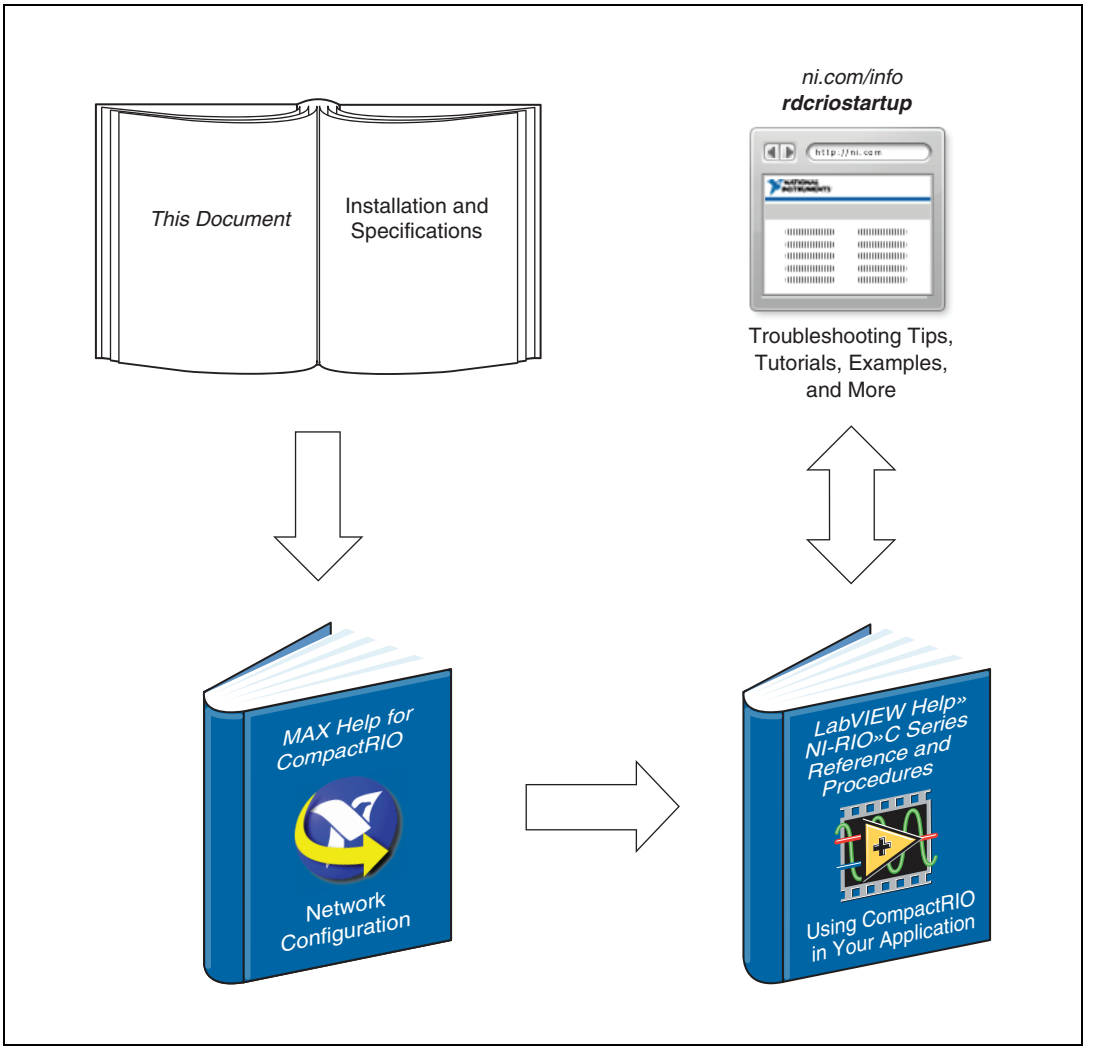


Figure 15. CompactRIO Documentation

Specifications

The following specifications are typical for the –40 to 70 °C operating temperature range unless otherwise noted.

Network

Network interface ..... 10BaseT and 100BaseTX Ethernet

Compatibility ..... IEEE 802.3

Communication rates ..... 10 Mbps, 100 Mbps, auto-negotiated

Maximum cabling distance ..... 100 m/segment

Reconfigurable FPGA

FPGA type ..... Xilinx Spartan-6 LX 45

Number of flip-flops 54,576

Number of 6-input LUTs 27,288

Number of DSP 48s 58

Available block RAM ..... 2,088 kbits

Number of DMA channels 5

Power Requirements

Caution You must use a UL Listed ITE power supply marked *LPS* with the NI 9146.

Recommended power supply ..... 24 W, 24 VDC

Power consumption ..... 15 W maximum

Power supply input range ..... 9 to 30 V

Note The power consumption specifications in this document are maximum values for a LabVIEW FPGA application compiled at 40 MHz. Your application power requirements may be different. To calculate the power requirements of the NI 9146, add the power consumption/dissipation for the chassis and the I/O modules you are using. Keep in mind that the resulting total power consumption is a maximum value and that the NI 9146 may require less power in your application. For more information about the I/O module power requirements, refer to the module operating instructions.

Physical Characteristics

If you need to clean the chassis, wipe it with a dry towel.

Screw-terminal wiring .....0.5 to 2.5 mm^2 (24 to 12 AWG) copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end

Torque for screw terminals.....0.5 to 0.6 N · m (4.4 to 5.3 lb · in.)

Weight .....643 g (22.7 oz)

Environmental

Operating temperature
(IEC 60068-2-1, IEC 60068-2-2) .....–40 to 70 °C

Note To meet this operating temperature range, you must compile your LabVIEW FPGA application at 40 MHz or slower and follow the guidelines in the installation instructions for your system.

Storage temperature
(IEC 60068-2-1, IEC 60068-2-2) .....–40 to 85 °C

Ingress protection .....IP 40

Operating humidity
(IEC 60068-2-56) .....10 to 90% RH, noncondensing

Storage humidity
(IEC 60068-2-56) .....5 to 95% RH, noncondensing

Maximum altitude.....2,000 m

Pollution Degree (IEC 60664).....2

Indoor use only

Shock and Vibration

To meet these specifications, you must panel mount the chassis and affix ferrules to the ends of the power terminal wires.

Operating shock
(IEC 60068-2-27) .....30 g, 11 ms half sine
50 g, 3 ms half sine,
18 shocks at 6 orientations

Operating vibration, random
(IEC 60068-2-64) ..... 5 g_{rms}, 10 to 500 Hz

Operating vibration, sinusoidal
(IEC 60068-2-6) ..... 5 g, 10 to 500 Hz

Safety Voltages

Connect only voltages that are within these limits.

V terminal to C terminal ..... 30 V max,
Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do not connect the system to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

This product meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

Note For EMC compliance, operate this product according to the documentation.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EEC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the Declaration of Conformity (DoC) for this product for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit `ni.com/environment/weee`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。
(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class 1, Zone 2, AEx nC IIC T4 and Ex nC IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class 1, Zone 2, Ex nL IIC T4
Europe (DEMKO)	Ex nA nL IIC T4

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`. If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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